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Event analysis and feedback as intervention techniques to stimulate activity for safe and healthy work

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This licentiate thesis is based on the following papers:

Paper I: Eklöf M & Törner M (2002) Perception and control of occupational injury risks in fishery. A pilot study. *Work and Stress,* 16(1), 58-69.

Paper II: Törner M & Eklöf M. (2002) Participatory analysis of accidents and incidents as a tool for increased activity in safety work among fishermen. A pilot intervention study. Submitted.

Paper III: Eklöf M, Hagberg M, Toomingas A & Wigaeus Tornqvist E (2002) Feedback of workplace data to individual workers, workgroups or supervisors as a way to stimulate working environment activity. A cluster-randomised controlled study. Submitted.

Contents

1. Introduction

1.1 The problem areas generally

The general aim of this licentiate thesis was to contribute to the research-based knowledge about working-life interventions for improved safety and health. The main issue dealt with was how health and safety related behaviour could be influenced through psychological interventions at the workplace. The interventions had as a common element the problem of integrating efforts of researchers, occupational health services and workers with the ultimate aim of improving safety and health at work.

The studies reported in this thesis were made in two different kinds of work; fishery and office work in which the use of computers was common. Fishery is one of the most accident stricken occupations (91). Still, fishermen often do not give priority to preventive safety work. Musculoskeletal complaints are common among computer workers. The magnitude of the problem is not matched by knowledge concerning its prevention and management.

Study I in this thesis was a cross sectional questionnaire study of safety-related cognitions, attitudes and behaviours among Swedish fishermen. Study II was a study of an intervention among Swedish fishermen. Study III was a cluster randomised controlled field experiment based on feedback techniques and involved Swedish white-collar workers.

1.2 Conceptual issues

Since the term “accident” may have connotations that imply unpredictability and unpreventability, it has been suggested (24) that it should not be used. This is because many “accidents” may be predicted as well as prevented. A generally accepted alternate term does not seem to exist, however.

Hagberg *et al* (44) suggested that “occupational injury” should be defined as “any damage inflicted to the body by energy transfer during work with a short duration between exposure and the health event…” In this thesis, the word “injury” will be used to denote an unintentional event where someone was injured (in which case the duration between exposure and health effect was short). If the event did not result in injury, but could have done so if intentional or unintentional circumstances had not prevented this late in the chain of events, I will speak of a “near-injury event”.

Events (or stable working conditions and –behaviour) may have health effects that do not show until after repeated or prolonged exposure (44). This category of events may among others include events that may be causally linked to musculoskeletal disorders and illnesses as well as psychological stress. The general conceptual frameworks for the understanding of injuries and near injury events may be applied for the understanding of such “prolonged events” also. I will call such events “exposure episodes”

The word “interventionist” will be used to denote persons who enter an organisation or group with the explicit intention of influencing it.

The word “participant” denotes a person who is a member of the organisation or group being intervened into and who participates in activities that are part of the intervention.

1.3 A general framework for occupational safety and health problems and intervention

1.3.1 Some general features

Before and during an injury/near-injury event or exposure episode various conditions may act to influence the outcome. Researchers in organisational psychology and researchers in injury prevention have developed systems usable for a general classification of areas for problem identification as well as intervention strategies. Below an attempt is made to summarise a number of relevant classification parameters. A key feature is that injury/near-injury events or exposure episodes are not seen as isolated phenomena. Rather, they are seen as related to factors of different natures and at different distances temporarily and spatially from the immediate events during which harm occurs. Interventions can be designed to focus any or all of these aspects. Since this thesis is about interventions among workers and their immediate supervisors, only aspects that may be in some sense influenced by these were of practical concern in the interventions studied.

Events follow each other in time. Conditions that may influence the probability and outcome of an injury, near-injury event or exposure episode can be operative at different points in time. Generally, one may speak of “pre-event” “event” and “post event” (9). The “pre-event” phase may be analysed further. Backström (7) discussed “lack of control”(a point in or segment of time when a work system can be said to become unstable; this can occur already during the design of the system), “loss of equilibrium” (a point in time where the instability becomes evident and some corrective action is necessary) and finally “loss of control” (the point in time at which the injury-inflicting forces come out of control). Unless something intervenes at this point, injury-inflicting forces may reach individuals, leading to an injury or an exposure episode.

Factors of different kinds can contribute to unsafe or unhealthy working conditions and –behaviour: Physical environment, work organisation and formal power distribution, technology, interpersonal relations, social norms and co-operation, incentives, recruitment, the way occupational safety and health is managed, organisational culture, the way an organisation interacts with its environment, legislation or other society-level phenomena (4; 9; 23; 54). The design of working environments and behaviour in them may be influenced by decisions and behaviour at higher levels of organisational or societal hierarchy as well as decisions and behaviour on lower levels. Finally, the role of individual characteristics can be considered.

Risk factors may influence the probability of specific injury types or influence the risk for injuries more generally.

Prevention can be active or passive. Passive prevention is directed towards creating working conditions where technology and organisation are such that workers are protected against injury by structural factors. Safety is not dependent on individual skill, cautiousness etc. Active prevention, on the other hand, requires worker action to avoid risk factors and is dependent on individual skill etc. (4; 9; 23). Passive prevention for all conceivable risks in a work system requires strictly structured work design: all possible behaviour must be foreseen. Such work design may be impossible to implement in fishery and office computer work and may in itself involve exposure to risk (low job control (57)).

1.3.2 Psychological, social and organisational factors in safety research

Safety research has considered personality, attitudes and cognitive factors on the individual psychological level as well as social and organisational factors. Combinations of such factors are considered in the context of "safety climate".

Personality is usually defined in terms of "traits", which are seen as enduring psychological characteristics in terms of "recurring regularities and trends in a person's behaviour"(49) that may be useful for differentiating among individuals. Associations between traits and involvement in injury events have been studied. Results have been inconsistent and inconclusive (64). This may in part be explained by the fact that other individual as well as situational factors play a role in determining if an individual gets involved in an injury event. As long as traits are regarded as stable characteristics and considering the inconsistent research findings, working life interventions into personality seem less promising.

An attitude is another type of individual characteristic. An attitude can be said to involve an evaluative position towards something (a "psychological object") (2). Positive attitudes towards workplace safety, low acceptance of risks and risk taking as well as low fatalism have been reported to predict lower injury rates in organisations (64), but social norms as well as specific situational factors are thought to influence the degree to which individual attitudes are actually expressed behaviourally (28).

Safety research has also studied associations between cognitive factors and involvement in injury events (64). Failure to attend to and/or properly interpret sensory clues to risks may lead to acute risk exposure and injury. Situations of hurry and stress may affect attention and cognitive processing negatively, thereby increasing the risk for errors. In cognitively oriented stress research (65), concepts have been developed that refer to cognitive processes of appraisal of and in stressful situations (situations implying threat to values and interests of the individual) as well as behaviour tendencies in such situations. Coping refers to the way in which the individual copes with stressful (e.g. hazardous) situations. The degree of problem-focused coping (actively attempting to control risk factors) is, according to theory, influenced by primary appraisal (perceived personal risk), secondary appraisal (perceived manageability of the threat) and individual

characteristics such as locus of control (82) and coping resources such as skills and social support. Perceived manageability is seen as a key factor for problem focused coping, and is influenced by individual characteristics and coping resources.

Social factors may include norms and distribution of authority. For example, norms in favour of safe behaviour may be associated with social reinforcement of such behaviour. Distribution of authority determines the influence behaviour and attitudes of any particular individual may have in a group. Supervisor, peer and team support for safe practices have been reported to be associated with lower injury rates (64).

Finally, organisational factors have been considered in the occupational safety context. The existence of safety regulations, recommendations and routines are among these. Job design may itself involve exposure to risks (64).

The concept of a "safety climate" combines factors of the kinds described above. Flin et al (36) reviewed 18 measures of safety climate. Common features of these measures were identified: (1) Management and supervisor attitudes and behaviour with respect to safety; (2) organisation of safety work, safety policies and regulations, standard of safety equipment ("safety system"), (3) risk perception, risk behaviour, attitudes and personality dispositions towards risks ("risk"); (4) work pressure, balance between production and safety and (5) competence and skill in the workforce, supervisors and management. Ten of the measures had been tested with respect to association with injury data. Findings were not entirely consistent, so although the predictive validity of safety climate measures were found to be encouraging, the authors found further study and refinement necessary.

Note that adequate technology is implied as important for safety. The standard of technology has obvious implications for safety; fallible equipment may lead to risk exposure and injury. The ability and willingness to implement safe equipment and use it safely probably depends on the kinds of psychological, social and organisational factors discussed above as well as the interplay between ergonomic characteristics of the equipment, the characteristics of the individual user and situational demands.

An unresolved issue in the safety climate context is whether it is possible to define a generic model of safety climate or if the essentials of safety climate vary across trades, organisations, cultures and situations (25; 36).

Fishery is one of the most injury stricken occupations (91). Still, fishermen often do not give priority to preventive safety work. Economic considerations are predominant in this context. In order to maintain an acceptable income, the fishermen go to sea in increasingly severe weather conditions or may overload their boats to secure a large catch (72). In studies of fishery, perceived risk as well as attitudes and cultural norms favouring fatalism and risk acceptance have been claimed to counteract active safety work and rather be directed towards handling the job, in spite of the risks (72; 80; 91). However, research into the role of psychological factors in safety among fishermen is rare. Murray *et al*. (73) studied

relations between fatalism (external locus of control), anxiety and worries, respectively, and injury exposure as well as activity in safety work, among Newfoundland fishermen. Results concerning injury exposure were inconclusive, but (non significant) associations between (low) fatalism and (low) anxiety, respectively, and activity in safety work, were found.

Study I was designed to explore whether similar results could be found among Swedish fishermen; study II included an attempt to study these aspects on a more specific level, using a case study approach.

1.3.3 Ergonomic, psychosocial and individual factors as predictors of musculoskeletal disorders

Musculoskeletal complaints are common among computer workers (31). Such complaints have been found to be associated with ergonomic as well as psychosocial factors at work (13; 76).

Workplace design (ergonomic qualities of the equipment itself, its layout and the general physical working environment) and working technique (working postures and specific ways of performing tasks) are some of the ergonomic factors that may be related to an increased risk for developing upper extremity musculoskeletal disorders.

Psychosocial factors are commonly defined in terms of job demands (amount of work and speed requirements but also cognitive and emotional demands), job control (variation, learning, influence over decisions concerning the job) and social support from peers and management (51; 57). High demands, low control and poor social support are seen as risk factors for stress. Stress may manifest itself as increased tension psychologically as well as biologically (67).

The role that individual psychological characteristics may play in the etiology of musculoskeletal disorders/illnesses has been studied. For example, since psychological stress is thought to play a role in the etiology of such disorders/illnesses, all individual psychological characteristics studied in stress research may be relevant (e.g. type-A behaviour, hardiness, locus of control, neuroticism, sense of coherence (85)). Focussing on individual differences in occupational health research may however be interpreted as encouraging "victim blaming". Furthermore, ergonomics is about "fitting the task to the man", so although individual psychological characteristics may play a role, the analysis of problems and the design of ergonomic working life interventions may focus entirely on job design, equipment and environmental factors. However, one individual factor that is of concern in ergonomics is working technique, which could be hypothesised to be to some degree related to personality.

Although individual psychological characteristics may play a role, the office work intervention study (study III) reported in this thesis did not consider other individual characteristics than working technique.

1.3.4 Decision making processes vs. specific factors related to events
Problem analysis and interventions can be focused on specific risk factors and measures or focused on the processes of problem analysis and decision making during which work systems are (re)designed or measures decided upon (5; 12; 42; 86).

The processes of problem analysis and decision-making can be intervened into normatively by implementing standardised methods. Feedback of working environment and working behaviour data involving recommended procedures for analysis and decision-making is an example of this (74; 83). Processes can also be intervened into in a less normative way. A basic principle can be to support the participants´ ability to identify problems in the process as it looks in normal practice. Schein´s model of process consultation in organisations is an example of a framework for such an intervention approach (86). A central aspect of the interventionist role is to support the generation of "actionable knowledge"(5), that is, information (that participants can accept as valid) about specific conditions that are observable, describable and within reasonable control of the participants.

1.3.5 The relation between parties involved in problem analysis and intervention
The relations between persons (interventionists and participants) involved in problem solving and decision making can be classified along the dimension symmetry-complementarity (92). One type of relation may be that between expert and non-expert, that is, a complementary relation in which the expert party strives to transfer some of his expertise to the other party. This kind of relation may be directly directive or more directed towards transferring information that the non-expert party is supposed to use to manage his problems. Another type of relation may be of a more collaborative nature, in which a more symmetrical relation is sought and where both parties are seen as having different but equally valuable expertise in relation to the problem (5; 12; 86). This latter type of approach, when involving representatives from all parts of a work system, may be referred to as "participative". Some arguments for participation are: (1) Different stakeholders may have unique information valuable for analysis or intervention. (2) Effective cooperation between different stakeholders may result in better analyses and solutions. (3) Participation increases the probability that analysis and solutions are perceived as exhaustive, adequate and fair, which may increase the probability that solutions are implemented according to intention. (4) Poor influence over decisions has been identified as a risk factor for health problems. (5) It is in accordance with general democratic values. Much intervention research has emphasised the benefits of a participatory approach (5; 6; 11; 25; 33; 43; 45; 53; 61; 83; 88; 94).

1.4 Intervention research in fishery

The need for psychological methods in fishery interventions was based on experiences among occupational health engineers and researchers engaged in injury prevention among Swedish fishermen (90). The essence of these

experiences was frustration over the ineffectiveness of normative safety interventions among fishermen (telling them what they ought to do in order to work safer). An intervention strategy that would actively engage and motivate participants was seen as desirable. It should be noted though, that normative safety programs in fishery, based on systematic problem analysis and involving legislation, education and technological aids, have been reported to be successful (19; 66) in reducing fatalities.

I did not know of and could not find in the literature any examples of participatory, process-oriented interventions in fishery that concentrated primarily on the process of problem identification and decision-making.

1.5 Intervention research related to office ergonomics

Results from studies of interventions into ergonomics in general (94) and into office ergonomics specifically (1; 14; 27; 69; 95) as well as interventions against stress (15; 16; 21; 26; 32; 34; 35; 48; 56; 61; 70; 71; 79; 81; 88), among them interventions for improved psychosocial conditions, show inconclusive results. Some authors put forward management support, worker participation, pluralism, effective problem identification, analysis and decision making and learning from experience as important success factors (43; 52; 61; 88; 94), while others recommend clearly defined changes in job design, job demands and equipment (1; 79) (such clearly defined changes have been preceded by a (adequate or not) decision making process).

One reason for some of the uncertainty surrounding intervention effects can be the relative scarcity of controlled studies with good internal validity (79; 94). Problems of feasibility may explain this in part. Randomised controlled studies in real working-life settings demand a degree of compliance from participants that may be incompatible with work demands or individual or organisation-level interests.

The adequacy of health effects or macro-level exposure factors, with complex causal background, commonly used as evaluation variables has also been questioned. It has been identified as desirable to study variables that illuminate processes of initiation and implementation of change in behaviour or exposure to risk factors (41; 62; 78).

1.6 Feedback research

Feedback may be a component in working life interventions for improved health and safety as well as improvements in organisational performance (23; 33). Feedback is an intervention directed at processes associated with problem analysis and decision-making. A feedback intervention may be defined as “actions taken by (an) external agent(s) to provide information regarding some aspect(s) of one’s task performance”(60). In this particular context the “task” is to behave safely at work and arrange work so that such behaviour is possible. The “action” referred to may be part of everyday leadership and cooperation, but may also involve specific

planned interventions where data relevant for safe behaviour and safe environment is collected and fed back systematically.

The basic theoretical idea is that feedback that indicates deviation from task performance goals will lead to improved goal attainment. Research results concerning effects of feedback interventions have been contradictory (60; 74; 83; 84). This may be explained with reference to a number of factors that may moderate between feedback and task performance effects (60):

- Relevance and validity of feedback. Feedback should be accepted as valid, relevant and consistent with other sources of information.
- The existence of (attractive) performance goals against which feedback can be compared. Inconsistent and conflicting goals make comparison difficult and its results difficult to predict.
- Feedback content. The degree to which feedback information is interpreted as indicating (undesirable) deviations from performance goals (which may be complex).
- The nature of feedback. Unspecific, evaluative and/or interpersonally communicated feedback may direct focus towards central values such as self-esteem and divert attention from feedback and specific task performance.
- Emotional reactions to feedback. Unpleasant emotions as well as low or high arousal evoked by feedback information may decrease the cognitive ability to find solutions to improve goal-attainment.
- Motivation to act in the pursuit of better goal attainment. The degree to which it is believed possible to change task behaviour successfully. This is influenced by individual characteristics as well as appraisals of environmental conditions such as task difficulty, availability of structural resources and social support. Feedback information may not indicate how performance-standard discrepancies could be eliminated. Experimentation to find adequate behaviour may (as long as it is unsuccessful) lead to impaired performance and, in the long run, disbelief in the possibility of improving performance.

Evaluations of working life feedback interventions have indicated that feedback in itself may be a weak intervention and emphasise the importance of effective management involvement, effective worker participation and effective feedback information processing (interpreting, analysing and drawing practical conclusions from feedback data) (10; 74; 75). Participative interventions commonly use the group setting as an intervention arena. However, successful group participation requires resources with respect to communicative competence and non-defensivity among participants that may not be available (5; 63). Feedback providers may also have to work within time constraints that limit the possibilities to effectively manage participative feedback processes. Furthermore, it has been suggested that interventions should be tailored according to the readiness or motivation for change that is present among participants (47; 60). Feedback interventions with weak control over factors related to effective information processing and participant readiness for change could thus be expected to have small or unpredictable effects. Still, such interventions are common and therefore important to evaluate.

When less than optimal conditions are present, the communication and processing of information during feedback may well function more effectively in a two-person setting than in a group setting, due to less complex communication patterns. A study that compared feedback (of ergonomic assessment data) to groups with feedback to group supervisors only (68) found that the group setting generated more ideas but that the supervisor setting was associated with a higher degree of implementation of ideas. The results suggested that feedback to individuals in a leader position might be more likely to result in action. Another two-person feedback situation occurs when ergonomists, after inspecting individual workplace characteristics and working technique, discuss their findings with individual workers, trying to bring about change in ergonomic knowledge, workplace design and behaviour. According to experience, the latter strategy is common among Swedish ergonomists.

1.7 The aims of this thesis

1.7.1 General aim

The general aim of this licentiate thesis was to contribute to the research-based knowledge about working-life interventions for improved safety and health.

1.7.2 Questionnaire study among fishermen (study I)

Although the specific roles psychological factors may play in the context of occupational injury causation remain unclear, there is evidence that such factors are of importance when trying to understand why occupational injuries occur. Psychological factors may also be related to activity in safety work. Studies from other fishery nations have suggested that activity in safety work may be counteracted by low perceived risk, fatalism and risk acceptance. Since such psychological factors may be influenced by local/regional/national cultures, a study of relations between psychological factors and activity in safety work among Swedish fishermen was of interest. Therefore, the specific aims of study I were:

1. To explore degree of self-reported injury/near-injury event experience, perceived personal risk, perceived manageability of risks, perceived sufficiency of technical knowledge, fatalism, risk acceptance and self-rated activity in safety work among Swedish fishermen.
2. To explore associations between experience of injury and near-injury events, perceived personal risk, perceived manageability of risks, technical knowledge, fatalism and risk acceptance, respectively, and activity in safety work among Swedish fishermen.

1.7.3 Intervention study among fishermen (study II)

Participatory, talk-based, interventions in fishery have, to our knowledge, not been scientifically reported. So there is a lack of scientific knowledge about both the feasibility and effects of such interventions. Furthermore, occupational health

practitioners and safety intervention researchers have, on the basis of frustration from expert-strategy interventions into fishery, expressed a need to explore alternative intervention strategies. Therefore, the specific aims of study II were:

1. To create participative arenas for exchange of experience and discussion of safety issues among Swedish fishing crews.
2. To test a structured way of documenting and analysing injuries/near-injury events.
3. To study occurred injuries/near-injury events and their causes.
4. To study how participants managed injuries/near-injury events and their causes.
5. To study intervention (aims 1-2) effects on perceived manageability of risks, risk acceptance and activity in safety work among participants.

1.7.4 Feedback intervention study (study III)

Randomised controlled working-life intervention studies in the field of ergonomics of computer work are uncommon. Feedback techniques are part of the established toolbox of working-life interventionists, but controlled studies of their effects are not easy to find. Therefore the specific aim of study III was to test whether feedback of ergonomic and psychosocial working environment data to individual, groups or supervisors of white-collar computer workers had effects on occurrence of modifications in ergonomic and psychosocial aspects.

2 Methods

2.1 Study designs

The questionnaire study among fishermen (study I) was cross sectional.

The intervention study among fishermen (study II) was a quasi-experiment with a pretest-posttest one-group design. However, the emphasis was on qualitative information from group discussions and interviews.

The feedback intervention study (study III) was a randomised and controlled study. Randomisation was applied at group level. Experimental as well as control conditions were balanced across interventionists and participating organisations.

2.2 Participants

2.2.1 Questionnaire study among fishermen (study I)

The respondents (n=92) were not randomly selected or according to special criteria, but were fishermen with whom the project group came into contact through other projects, or who contacted the fishermen's occupational health services for yearly routine health check-ups. Age among the respondents ranged from 17 to 62 years. Mean age was 44 years and standard deviation 11 years. Years of experience as fishermen ranged between 1 and 48, the mean being 25 years and the standard deviation 12 years. 74% of the respondents resided on the west coast of Sweden, 9% on the Swedish east coast, 10% on the south coast, while 7% were fresh water fishermen. 86% of the responding fishermen had a spouse (or equivalent), and 53% had children under the age of 18. 23 % stated that they were alone on board (single crew). 67% were skippers, counting the single crew. 80% were owners or part owners of the fishing vessels.

2.2.2 Intervention study among fishermen (study II)

Potential participants were identified among fishermen known by the researchers or within their professional networks. Thus, the study was based on a convenience sample. Nine active crews from the Swedish west coast were contacted, 3 refused to participate due to lack of interest. Eleven persons participated at group meetings. All were male trawl fishermen aged 17-55 years. Seven persons provided baseline questionnaire data, 6 provided follow up data, the 7th could not be reached. Follow up interviews reached 10, the 11 th could not be reached. In interviews 7 reported that genuine safety interest motivated participation, while 3 reported to have "followed along".

The modest sample size was mainly due to the practical difficulties in recruiting fishermen to our relatively time-consuming intervention. This in turn had to do with the fact that no tradition of participatory safety work of this kind existed in Swedish fishery and that fishery is an uncommon occupation.

2.2.3 Feedback intervention study (study III)

Eight ergonomists (7 women) with experience from workplace intervention work were recruited from the researchers´ networks and were given special training in data collection and feedback techniques (≈6h). Additional support to the ergonomists was provided at individual meetings (≈2h) and otherwise when needed during the entire study period.

Participating organisations were recruited by the ergonomists. Eligibility criteria for organisations were: (1) They should be among the normal clients of the partici-pating ergonomists. This meant that personal contact between ergonomist and organisation representatives was already established. The organisations should (2) be known by the ergonomists to have concern for the ergonomics of computer work; (3) accept randomisation (including a control condition) and be able to contribute 4 workgroups to the study; (4) accept that the intervention would not involve expert suggestions for measures; (5) accept that individual participant data were identified, making a repeated measures design possible.

Management representatives helped to identify suitable groups. Eligibility criteria for groups were: (1) all workers should be white-collar; (2) computer work should be common (specific criteria were not applied but, as it turned out, all participants used computers during work); (3) concern for ergonomics should be high; (4) they should be organisational subunits, each with its own supervisor; (5) they should have 6-20 members (a group size of about 8 was considered ideal); (6) group members and supervisor should meet organisational eligibility criteria 3-5. Individual level eligibility criterion for inclusion in the intervention effect analysis was that participants should have worked at least 4 months at the present work-place at baseline. This criterion was applied because retrospective self-reports of workplace modification activity were used as dependent variables in this study.

Twelve organisations were contacted, 9 accepted to take part in the study. Thus, 36 groups were recruited. For details concerning organisation, group and individual level participation at different stages of the study, see figure.

The 9 organisations represented the following trades: Banking (3x4 groups), transport (4 groups), manufacturing industry (4 groups), software engineering (4 groups), public administration (2x4 groups) and wholesale (4 groups). One organisation in public administration, the wholesale organisation and the software engineering organisation were located in small towns in the southwestern part of Sweden. The remaining organisations were located in Göteborg, Sweden. Recruitment, interventions and data collection were performed November 1998-January 2000. Individual participation was voluntary and all participants were informed about the project design.

All participants used computers during work. Group level background data at baseline (for the participants who took part in the entire study and fulfilled the individual level eligibility criterion) are shown in table 1.

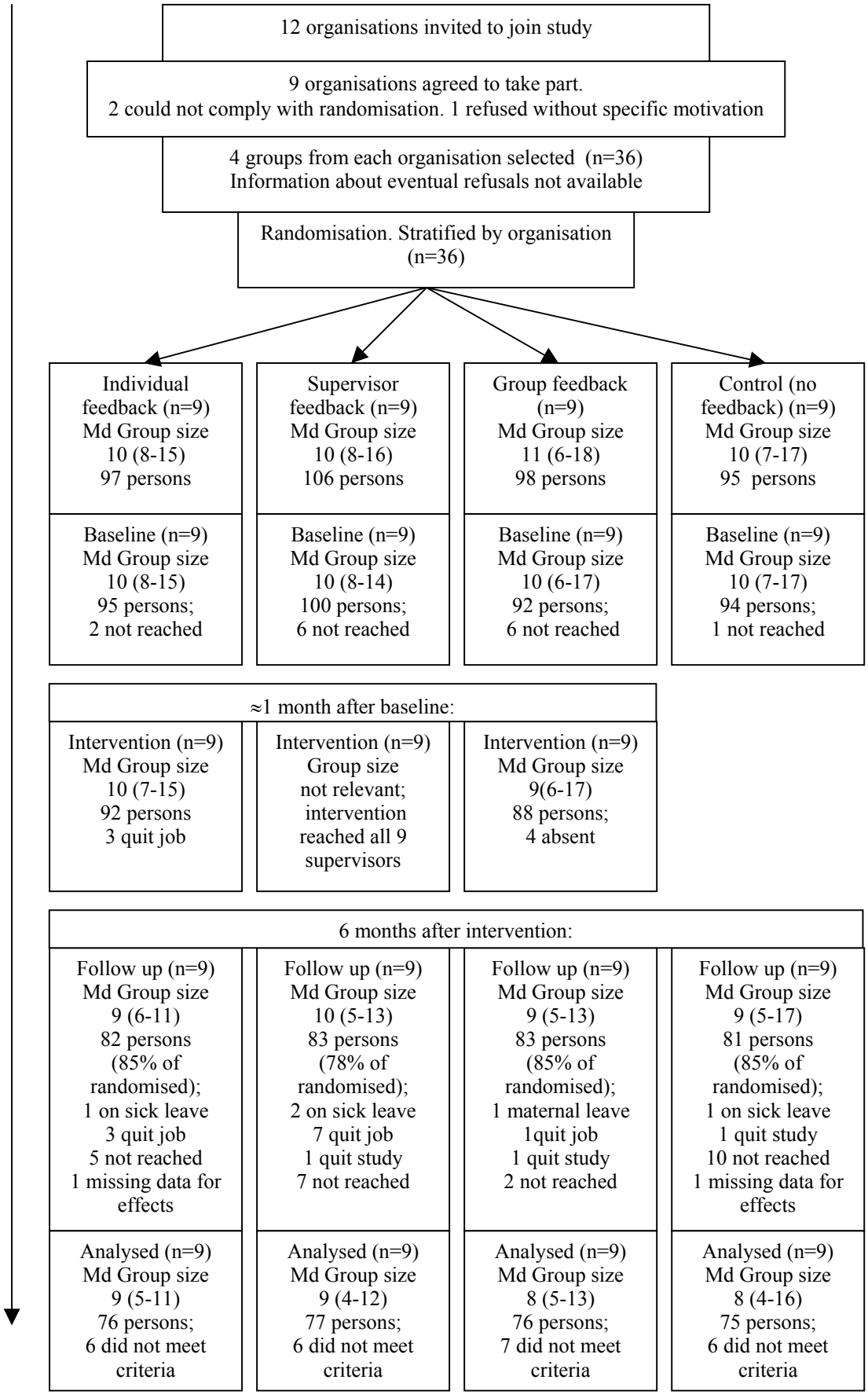

Figure. Participant flow through the stages of study II.

Table 1. Group-level background variables at baseline.

		Total	Individual feedback	Supervisor feedback	Group feedback	Control
		n=36	n=9	n=9	n=9	n=9
Sex (% women)						
	Median	79	67	67	88	83
	Min; max	0; 100	0; 88	22; 100	31; 100	0; 100
Age (group means)						
	Median	43	46	46	43	40
	Min; max	30; 55	36; 54	36; 55	34; 53	30; 49
Education (% university level)						
	Median	20	20	20	20	33
	Min; max	0; 80	0; 64	10; 44	0; 40	0; 80
Employment form (% conditional employment)						
	Median	100	100	100	100	100
	Min; max	20; 100	73; 100	88; 100	63; 100	20; 100
Normal working time/week (group means)						
	Median	38	38	38	39	36
	Min; max	33; 44	34; 40	35; 42	33; 44	36; 43

2.3 Randomisation and blinding (study III)

As soon as 4 groups from an organisation had been identified and accepted participation, they were numbered by the ergonomist. This information, along with number of group members, was sent to the author, who at this stage had no further information about the working conditions of the groups. The groups were allo-cated to one of the four study conditions by the author who, blindfolded, shuffled and drew cards from a box with two sets of four identical cards numbered 1-4. Four pairs of cards were drawn. The first card in each pair indicated group number, the second indicated study condition. In this way the organisation factor was balanced across study conditions. Finally, participant lists with individual id-numbers indicating individual, group, organisation and study condition were set up and distributed to the ergonomist, who allocated id-numbers to individual group members. In this way, all participating workers and supervisors were made anonymous to the researchers.

The matching of ergonomist and group was not random but each ergonomist gave feedback in all three variants. In this way the ergonomist factor was balanced across study conditions.

Neither the ergonomists (the data collectors/feedback providers) nor partici-pants were blind with respect to study condition.

2.4 Intervention design and implementation

2.4.1 Intervention study among fishermen (study II)

After an introduction seminar at which general discussions about safety in fishery were held and results from study I were presented, the participating crews were divided into two groups with initially 3 crews in each (6-8 persons), according to home harbour.

The following agreements were made between researchers and participants: (1) experiences and reflections among participants should be the major working material at group meetings; (2) participants were responsible for providing such material; (3) injury/near-injury event diaries should be used regularly; (4) a near-injury event should be defined as an event that could have resulted in injury, had the circumstances not prevented this; (5) all crews should make up a specific safety action plan at the end of the meeting period.

Over a 10-month period each group met 6 times for 1.5 to 2 hours. A psychologist and an ergonomist well acquainted with fishery and its language led the meetings. Their role was to facilitate expression of experience and reflection by posing questions and to make sure each event was worked through (see below). The strategy built on ideas about process consultation (86) and focused on how participants worked on their task (analysis of injuries/near-injury events, analysis on how injuries/near-injury events and hazards were and could be managed and actual behaviour in pursuit of risk reduction), not general social processes in the group or individual characteristics. The second strategy was to avoid giving expert advice except in instances where such advice was explicitly asked for in connection to some specific problem under discussion. An OHS engineer took part in order to make technological support directly available.

Between meetings, all injuries/near-injury events during work were to be noted in a diary kept aboard. All injuries/near-injury events noted or remembered were analysed and discussed during the group meetings. The discussion leaders made sure that the following aspects were worked through for each event: (1) description of event; (2) identification of basic factors (the basic cause of the injuries/near-injury events, e.g. equipment poorly fixed) and releasing factors (conditions that simplified for the basic cause to act, e. g. rough seas, that made the loose equipment move about); (3) classification of causal factors as technological, organisational or individual; (4) discussion of how the event and its consequences were coped with; (5) for each causal factor: discussion of preventive measures.

2.4.2 Feedback intervention study (study III)

The intervention was designed to provide normative information about computer ergonomics and psychosocial factors, to feed back information concerning the ergonomic and psychosocial situation among participants and to stimulate discussion of these matters.

Three feedback conditions were used: Individual feedback to each individual in the group, feedback to the group supervisor alone and feedback to entire group with the supervisor present. The ergonomists did not present lists of suggested

measures but supported the participants´ own analysis of the feedback information and their discussion of it.

Feedback meetings were planned to last for approximately 1 hour and were held within a month after collection of baseline data. Feedback was given orally and through printed brief reports to all feedback recipients. OH-presentations were used at group feedback meetings. The information included: (1) self-reported extent of computer work; (2) self-reported physical complaints >=3 days the last month (neck, shoulders, arms, hands or lower back; eye complaints; headache); (3) Comfort (58) during computer work the last month (with reference to key-board placement, placement of input device, screen placement, working area, working position, chair, general light conditions, light conditions at the workplace, daylight screening, noise level and indoor climate); (4) expert-evaluated ergo-nomic standard (46) of workplace design (chair, table, screen placement, keyboard placement, placement of input device, vision conditions) and working technique (at the keyboard and with the input device). The evaluations were expressed in terms of "non-optimality", which meant that expert-defined ergonomic criteria were not met by all observed characteristics. (5) Psychological demands, decision latitude, social support (57; 89) and self reported overtime work (all referring to the last month). Definitions of all these variables and general information about their relevance to working environment and health were provided at the feedback meetings.

Data came in the form of group mean values and frequency distributions. In the individual feedback condition the results for the individual in question were also reported. Reference data from a parallel study among other Swedish computer users were provided (59).

On the group level, the study conditions were similar with respect to the results that were included in the feedback information (table 2).

Table 2. Group level baseline values for the aspects included in the feedback information.

	Total (n=36)	Individual feedback (n=9)	Supervisor feedback (n=9)	Group feedback (n=9)	Controls (n=9)
% of working hours at computer (group means)					
Median	72	67	79	73	71
Min; max	48; 100	48; 98	53; 100	48; 91	57; 99
Hours overtime latest month; (group means)					
Median	8	7	10	7	8
Min; max	0; 25	0; 11	1; 25	3; 19	4; 20
% physical complaints [a]					
Median	60	55	70	60	67
Min; max	25; 100	25; 70	52, 100	33; 80	40; 100
Average number of "not optimal" workplace design aspects					
Median (could vary 0; 6)	3.3	3.5	3.0	3.4	[c]
Min; max	1.0; 4.3	1.0; 4.3	1.8; 4.0	2.4; 4.0	[c]
Average number of "not optimal" working technique aspects					
Median (could vary 0; 2)	1.3	1.3	1.3	1.4	[c]
Min; max	0.4; 2.0	0.5; 2.0	0.4; 2.0	0.5; 2.0	[c]
Comfort [b]; group means					
Median (could vary –4.0; 4.0)	1.3	1.4	1.3	1.3	1.2
Min; max	-1.1; 2.3	0; 2,3	0.2; 1.7	0.4; 1.9	-1.1; 1.8
Job demands; group means					
Median (could vary 1.0; 4.0)	2.8	2.8	2,8	2.8	2.9
Min; max	2.0; 3.3	2.4; 3.3	2.4; 2.9	2.0; 3.2	2.4; 3.0
Job control; group means					
Median (could vary 1.0; 4.0)	2.9	3.0	3.0	2.9	2.9
Min; max	1.7; 3.4	2.1; 3.4	2.4; 3.3	1.7; 3.1	2.5; 3.4
Social support; group means					
Median (could vary 1.0; 4.0)	3.3	3.4	3.2	3.4	3.2
Min; max	2.1; 3.8	2.8; 3.8	2.9; 3.6	2.1; 3.8	2.8; 3.8

Notes: [a]: Neck, shoulders, arms, hands, lower back, eyes or headache at least 3 days the last month.
[b] : With reference to workplace design. [c]: Data not available

The ergonomists noted disturbances during feedback sessions and session time. Few disturbances were reported and the average session time was 38 min (individual), 61 min (supervisor) and 85 min (group). Seven participants did not receive feedback (figure). The ergonomists noted the approximate proportion of session time spent discussing psychosocial aspects and workplace design/working technique. The distribution was similar in the three feedback conditions (≈50/50).

2.5 Measurement variables and data collection

2.5.1 Questionnaire study among fishermen (study I)

A questionnaire was designed for use specifically among fishermen. Before data were collected, the contents and wording of the questionnaire were discussed with

representatives from the fishing community. The questionnaire covered the following:

Background variables: Age, civil status, parenthood of under aged children, experience of fishery, type of fishery, geographical region and ownership of the fishing vessel and role aboard (skipper/non skipper).

Injury/near-injury event experience: This area was covered by 5 items referring to: (1) personal exposure to injury making medical care or sick leave necessary; (2) personal exposure to injury not making medical care or sick leave necessary; (3) personal exposure to near-injury event(s); (4) experience from situations where someone else aboard was injured to an extent that necessitated medical care or sick leave; (5) experience from situations where someone else aboard was injured but not to an extent that necessitated medical care or sick leave. The questions were formulated with reference to work in fishery during the latest 3 years. Response format was yes/no.

From these items the compound variable "injury/near-injury event experience" was construed (in the version of this study published in Work and Stress (30), this variable was called "accident experience"). Respondents who gave a "yes" response to at least one of the items in this area were classified as having injury/near-injury event experience.

Based on factor analysis, indices of the following were computed as raw score means:

Perceived personal risk: Risks associated with ten different working situations (unloading, hauling of gear, work in engine room, walking on deck, ladder or stairs, shooting of gear, embarking or disembarking, catch handling on deck, boxing in cargo hold, repair work or work by the quay, cleaning of vessel/gear) covering all work related activities on board were rated by the respondents. The activities were selected through an analysis of serious injuries in Swedish fishery, performed in a previous study (91). In this study all injuries leading to more than 30 days of sick listing, permanent disability or death, reported to the Swedish Labour Market No-fault Liability Insurance from July 1st 1983 – June 30th 1995, were studied. In the analysis of these injuries, activities in which the victim was engaged at the time of the injury were categorised into the ten groups of activities used in study I.

The form of the items in the present questionnaire was: "How high do you estimate the risk to be for you to be injured in connection to…?" The six-point scale end points were "very low risk" and "very high risk".

Perceived manageability of risks: Ratings were made of perceived manageability of risk, associated with each of the aforementioned working situations, with technical equipment or working methods. The form of the items was: "Accident or injury risks associated with … can be reduced with technical equipment and working methods". The six-point scale end points were "not at all correct" and "entirely correct".

Sufficiency of technical knowledge and skills related to equipment on board: This was hypothesised to be a significant coping resource and as such associated

with activity in safety work. The items referred to (1) technical equipment on deck, (2) in cargo hold, (3) engine room and (4) equipment for navigation and supervision of fishery operations and catch. The form of the items was: "To what degree do you consider yourself to have sufficient technical knowledge to manage the technology presently used on board in the following areas:…". The six-point scale end points were "not at all sufficient" and "entirely sufficient".

Fatalism: Degree of agreement to the following 2 statements: "Some higher power or luck protects me", "Fate, luck or other people´s actions determine whether I will be injured or not". The scale end points were "not at all correct" and "entirely correct".

Risk acceptance: Previous research (72; 80; 91) has put forth norms of fearlessness or risk acceptance as characteristics of culture in fishery. The 4 items in this area were based on descriptions of such norms given by cited literature (72; 80; 91). The items were: "You have to learn to live with the risks at work", "A fisherman should be able to take care of himself", "A fisherman should be prepared to take risks", "A fisherman should enjoy challenging the forces of nature", "Even if accidents happen, the risk is so small it's not worth thinking about". The six-point scale end points were "not at all correct" and "entirely correct".

Activity in safety work: This area was covered by 4 items: "I try to find methods and equipment to improve safety", "The crew co-operates to improve safety", "In our team, we often discuss how to improve safety", "It is an important part of the job to learn more about how to improve safety". The six-point scale end points were "not at all correct" and "entirely correct".

All indices had an internal consistency (Cronbach α) of >.70, except fatalism (α=.63; inter-item r=.46)

The data collection period was 8 months (1997-1998). The questionnaire was distributed to 71 fishermen during their visits to the occupational health services (all who visited during the data collection period) and to 21 fishermen during meetings with the authors or two occupational health engineers. The completed questionnaires were collected at the same occasions. Responses were given anonymously. The response rate was 100%. The rate of internal dropout was generally less than 5%.

2.5.2 Intervention study in fishery (study II)

In study II the same measures of perceived manageability of risks, risk acceptance and activity in safety work as in study I were used. Baseline questionnaire data were collected at an introduction seminar, before any survey results were presented. Follow up questionnaire data were collected by the authors immediately after the final group meeting.

Follow up interviews by telephone 2 months after the intervention period covered motives for participation, opinions about the intervention design and intervention process, the existence and content of safety action plans and effects attributed to participation. A researcher not further involved in this project and with whom the participants had had no previous contact performed the interviews.

During each meeting (including visits on board ships, where arrangements that had played a role in injuries/near-injury events could be observed) the group leaders took notes on: (1) behaviour that expressed cognitions, attitudes and emotions in relation to safety issues or the intervention itself; (2) descriptions of how injuries/near-injury events and identified hazards were managed behaviourally; (3) intensity of communication, distribution of activity during meetings and inter-crew interaction; (4) adherence to agreements concerning participant roles (See section 2.4.1); (5) reporting of injuries/near-injury events (see section 2.4.1). Observations were systematised shortly after meetings.

The intervention and data collection period was 1998-1999.

2.5.3 Feedback intervention study (study III)

In this section only the outcome measures that were used for this study will be described. Several other measures were used for feedback purposes only and were described briefly in the intervention design section.

The adequacy of health or exposure factors with a complex and largely uncontrolled causal background as evaluation variables in working life intervention research has been questioned. It has been proposed to be desirable to study more specific effects related to initiation and implementation of change (41; 62; 78). Intervention effects on activity to modify working conditions can be seen as a basic effect of this kind. This study used effect variables that reflected specific modifications in the working environment of computer users.

Since workgroups were the units of randomization group level measures were used in analysis (3; 20).

Group level modification occurrence proportions: In the baseline and follow-up questionnaires the participants indicated (yes/no) if they during the previous six months had experienced modifications (implemented by themselves or some other agent) with respect to 15 working environment aspects. Seven of these were classified under the term “ergonomics”: (1) visual conditions; (2) noise level or indoor climate; (3) new keyboard or input device; (4) work area, chair or table; (5) working postures (6) screen placement; (7) placement of the keyboard or input device.

Participants who answered “yes” in any of these respects were classified as having experienced ergonomic modification(s).

The remaining 8 items were classified as psychosocial: (1) work tempo or amount; (2) conflicting job demands; (3) demands for skill or inventiveness; (4) influence over decisions; (5) social support from colleagues; (6) support from supervisor; (7) time spent at the computer; (8) performance and reliability of the computer system. The latter two variables were put in this class because they were related to job design (psychological variation at work) and technical dependency, respectively.

Participants who answered, “yes”, in any of these respects were classified as having experienced modification(s) regarding psychosocial aspects.

For each group, the proportion of participants reporting modification in ergonomics and psychosocial aspects, respectively, was computed. These measures will be referred to as “modification occurrence proportions”.

Differences, between baseline and follow-up, in these proportions were computed and used as dependent variables in this study.

Group level modification breadth: By summing the number of specific aspects in the ergonomic and psychosocial areas, respectively, in which modifications were reported, individual level measures of modification breadth with respect to ergonomic and psychosocial aspects were construed. The possible variation was 0-7 for ergonomic and 0-8 for psychosocial aspects. Group means for these variables were computed.

Group-mean differences between baseline and follow up were computed and used as dependent variables in this study.

All data were collected after randomisation. Individual participation in data collection and feedback was voluntary. Questionnaire data collection was managed by the ergonomists at group meetings in the workplace. Ergonomic observation data (for feedback purposes only) were collected at the individual workplaces. The ergonomists were instructed to interfere with or comment on the subjects as little as possible during observations.

Baseline data were collected approximately 1 month before feedback sessions. In the feedback conditions, questionnaire data as well as ergonomic observation data were collected; in the control condition only questionnaire data. Scarcity of study resources motivated this imbalance.

Follow-up data were collected 6 months after feedback and included a questionnaire only, except for groups in the control condition that wished to have ergonomic observation data collected. These groups also received feedback at a later time. This possibility was acknowledged during the recruitment phase.

2.6 Data analysis

2.6.1 Questionnaire study among fishermen (study I)

The items in the areas perceived personal risk, manageability of risks, sufficiency of technical knowledge, fatalism, risk acceptance and activity in safety work were subjected to principal component analysis with varimax rotation. The scree test, the eigenvalues > 1 criterion (39) along with theoretical reasoning was used as guide for the number of components to extract. The Burt-Banks formula (18) and recommendations by Gorsuch (39) guided decisions concerning the magnitude of loadings to be interpreted (salient loadings). The resulting structure guided the formation of indices, the internal consistency (an indicator of reliability) of which was calculated using Cronbach´s α (22; 93).

Bivariate correlations were Pearson or point-biserial. Multiple regression was performed using the stepwise method (criteria: entry: $p<0.05$; removal: $p<0.10$). SPSS 10 was used.

2.6.2 Intervention study among fishermen (study II)

Interview responses and observations during group meetings were classified according to which study aims(s) they were relevant for. Injury/near-injury event data were classified using the format described in the intervention design section.

For the observations (except injury/near-injury event data and attendance) only the qualitative dimension was considered. For interview data quantitative information was also considered.

Changes in perceived manageability of risks, risk acceptance and activity in safety work were tested using the Wilcoxon matched pairs signed ranks test (87). Two-tailed p-values were computed.

The data source will be indicated in the results section; interviews, observations or questionnaire.

2.6.3 Feedback intervention study (study III)

Baseline values for group level modification occurrence proportions and group level modification breadths as well as changes in these from baseline to follow-up were tested for homogeneity across study conditions using Kruskal-Wallis tests (87).

Pairwise comparisons between controls and the intervention groups were performed to identify effects possibly associated with feedback, using Mann-Whitney U tests (87). Effect was defined as difference vs. controls (40) with respect to change in modification occurrence proportions or modification breadths from baseline to follow-up. SPSS 10 was used for these analyses. The error rate was controlled using the sequentially rejective Bonferroni test suggested by Holm (50). This test protects the overall error rate while being less conservative than the traditional Bonferroni procedure. In this case, where 3 pairwise comparisons for each effect were made, the procedure was: 1. Arrange the p-values for the 3 pair-wise comparisons in ascending order. 2. Is the lowest p-value ≤ alpha/3? If yes, reject the null hypothesis associated with this p-value. If no, accept all 3 null hypotheses and terminate the procedure. 3. Is the second lowest p-value ≤ alpha/2? If yes, reject the null hypothesis associated with this p-value. If no, accept this and the remaining null hypothesis and terminate the procedure. 4. Is the highest p-value ≤ alpha? If yes, reject the null hypothesis associated with this p-value. If no, accept the corresponding null hypothesis. The alpha level was set at 0.10.

3 Results

3.1 Study I

3.1.1 Descriptive

Thirty-seven percent of the respondents had been injured in fishery during the last three years. Sixty-two percent had experienced injuries or near-injury events involving themselves or others.

Means and standard deviations for perceived manageability of risks, risk perception, activity in safety work, risk acceptance, sufficiency of technical skills and fatalism are shown in table 3. On the average, the responding fishermen did not seem to perceive their job to be associated with high risks. Risks at work were perceived to be manageable to a fairly high degree (table 3).

The majority, 67%, considered their technical knowledge and skills to be sufficient (defined as a score >4 on a six point scale) for handling equipment on deck and in cargo hold; 50% felt confident about their knowledge and skills concerning the engine and 65% considered themselves to have sufficient knowledge and skills for handling the technical equipment on the bridge. The mean value for the index built from these variables was 4,6 on a six point scale, suggesting confidence about sufficiency of technical knowledge (table 3).

On the average, the respondents tended towards a low degree of fatalism, a moderate degree of risk acceptance and relatively high activity in safety work (table 3).

Table 3. Means and standard deviations of indexes for perceived manageability of risks, risk perception, activity in safety work, risk acceptance, technical skills and fatalism.

Index	Mean	S.D.
Perceived manageability of risks	4.5	1.0
Risk perception	3.0	0.8
Activity in safety work	4.7	1.0
Risk acceptance	3.2	1.1
Sufficiency of technical skills	4.6	1.0
Fatalism	2.5	1.3

Note: Means could vary between 1 and 6, higher value indicating more manageability etc.

3.1.2 Associations among indices and background variables

Bivariate correlations between the indices, injury/near-injury event experience and background variables, respectively, and activity in safety work reached significance for perceived manageability of risks (r=.32; p=.001) and perceived sufficiency of technical knowledge (r=.25, p=.014). All other variables except single crew (r=.14; p=.096), ownership of vessel (r=.07, p=.25), civil status (r= .12, p=.14) and fatalism (r=-.12, p=.12) correlated 0.0 with activity in safety work. Perceived risk, Perceived manageability of risks, risk acceptance, sufficiency of technical skills, fatalism, age, injury/near-injury event experience, civil status, parenthood of children under 18, years as fisherman, single crew, ownership of the fishing vessel and role aboard (skipper/non skipper) were used as predictor

variables in a multiple regression analysis, with activity in safety work as dependent variable. In the final model (table 4), all predictors except perceived manageability of risks, perceived sufficiency of technical knowledge and civil status were eliminated.

Table 4. Multiple regression (Stepwise, final model) of perceived manageability of risks, sufficiency of technical skills and civil status on activity in safety work.

	B	95% c.i. for B	β	t	p=
Constant	*2.5*	*1.20; 3.72*		*3.90*	*.000*
Perceived manageability of risks	.36	0.15; 0.57	.37	3.38	.001
Sufficiency of technical skills	.29	0.09; 0.48	.33	2.96	.004
Civil status	-.71	-1.30; -0.13	-.28	-2.46	.017
R= .48; p= .000					
R^2= .23					
Adj R^2= .20					

Among the final predictors, civil status was significantly associated with sufficiency of technical skills (r=.30, p=.004). Of the variables in the sufficiency of technical skills index, only sufficiency of technical knowledge related to equipment for navigation and supervision was significantly associated with activity in safety work (partial correlation, controlling for the remaining technical knowledge items = .45; p= .000). The other two items had partial correlations of -.11 and -.05 with activity in safety work.

3.2 Study II

3.2.1 Arenas for discussion and exchange of experience

Observations: One group initially had 8 members. One never attended, 2 attended 3 times. This meant that at least 5 participants were present at the meetings. The other group initially had 6 members. Two (1 crew) never attended, 2 attended once and 1 attended 3 times. In the latter group attendance was so small and irregular (most meetings were held with just 2 participants) that an effective inter-crew interaction could not be achieved. In the former group, attendance was more regular and interaction was more frequent between as well as within crews. Initially, the knowledge about fishery among the group leaders was "tested" by group members. After "approval", the group leaders were accepted as such and their interventions met no visible resistance. Both groups reported and discussed injuries and near-injury events according to the intended structure, guided by questions from the group leaders.

It happened that participants expressed frustration and embarrassment over how they managed safety. Such openness seemed to inspire other members to participate with their own feelings and thoughts on the matter. This kind of process seemed to create an air of increased motivation towards activity in safety work.

At times the discussion tended to deal with factors beyond the scope of the project, e.g. fish prices and fishery politics. These discussions presented an opportunity to air feelings of frustration and powerlessness. In these situations the strategy from the discussion leaders was to avoid lingering on issues beyond the scope of the project, by making questions to get focus back on potentially manageable things.

Interviews: All respondents appreciated the opportunity to exchange ideas and experience with other crews. Several wished that more fishermen with long experience had participated. All respondents stated that they had felt free to express observations and thoughts. Some thought that the activity among some of the fishermen had been too low. On the other hand, it was noted that: "fishermen are not that used to talking much".

Six of the respondents approved of the number and frequency of the meetings (6 meetings in 10 months), while 2 felt that the meetings were too many and too frequent. All respondents considered the duration of the group meetings to have been adequate. All respondents were interested in continuing the meetings in the discussion groups in co-operation with the OHS services.

3.2.2 Structured documentation and analysis of injuries/near-injury events

Observations: Several near-injury events had not been noted in the diaries but were remembered during meetings.

Interviews and observations: Diaries tended to be kept on the bridge and were thus not immediately available when events occurred. Often the skipper or an especially interested crewmember was perceived as responsible for diary keeping and the extent to which it was practiced depended upon the activity of this person.

Interviews: The diaries had been used at some time by 5 of the participants and 4 of these intended to keep using them after the project. Eight respondents considered diaries to be a good idea (near-injury events got documented, documentation was made available to other crew members, overview over injury/near-injury event types and frequency was facilitated) while the remaining 2 felt that the diaries were unnecessary – "important events are remembered anyway".

Observations: At all meetings except one, injuries/near-injury events were reported and analysed. Several serious near-injury events were reported during group meetings, but were so common that they were not seen as near-injury events but part of the normal and therefore not noted in the diary. Particularly slips and falls belonged to this category. The participants gave the impression of being well aware of the chain of events leading up to an injury or near-injury event. The distinction between basic and releasing factors was not always clear to the participants, however. Potential releasing factors that were impossible to avoid, such as weather or the presence of slippery matter on deck, could be seen as basic causes. This could lead to the false conclusion that prevention was impossible.

3.2.3 Technical expert support

Observations: Support from the OHS engineers was requested and provided concerning means to increase friction between feet and ship (more suitable boots and a way of covering slippery surfaces with high friction matter), hearing protectors with built-in radio communication facility and improved trawl boards. All requests grew out of previous analysis of near-injury events. In order to be accepted, proposed solutions had to be robust and practical rather than technologically sophisticated but with unproven reliability.

Interviews: More information on possible sources of economic support for safety improvements and information on how to go about applying for such funding was requested by respondents.

3.2.4 Occurred injuries/near-injury events and their causes

Observations: Injuries/near-injury events where crew members where jammed or hit were most common (table 1). Heavy parts of equipment (trawl, otter board, hook, block, engine, piles of fish boxes) that came out of control or broken wires were causes for these.

Slips and falls, caused by fish, oil or other slippery matter on deck, by combination of smooth walking/standing surface and footwear unsuitable for such surfaces, by a poorly fixed chair on the bridge or by failure to notice an open lid, were also common (table 5).

Table 5. Classification of injuries/near-injury events reported during group meetings.

Type of occurrence	n
Crew member got jammed or hit	24
Slips or falls	15
Ship leaking	2
Ship unmanageable	1
Physical overload on crew member	1
Sum	43

Weather, ship motions, stream conditions and their interactions were the most common releasing factors behind injuries/near-injury events. Deficient work methods, manifested in confusion or inadequate behaviour, as well as poor equipment function due to neglected maintenance were also relatively common (table 6).

Technological imperfections (events could have been avoided with better technology) were the most common basic causes of injuries/near-injury events, but conscious risk taking, lack of good routines and poor maintenance of equipment were also identified as frequent causes (table 6).

Table 6. Releasing factors and basic causes of reported injuries/near-injury events.

Releasing factor		n
Weather/ship motions/stream conditions		16
Deficient methods		10
Equipment poorly maintained		8
Circumstances beyond control of the fishermen		4
Hurry/exposed position		3
Faulty decision		1
Physical overload		1
	Sum	43
Basic cause		**n**
Technical layout chosen from effectiveness but without consideration to safety		16
Conscious risk taking, disregard of normal routines		7
Absence of basic technical safety solutions (e.g. slip resistance)		6
Technical arrangements without sufficient safety (e.g. worn hooks)		5
Lack of good routines (e.g. check list for greasing of machinery)		5
Equipment poorly maintained		2
Equipment damaged during fishing activity (e.g. trawl caught in sea bottom)		2
	Sum	43

3.2.5 Management of injuries/near-injury events and their causes

Observations: The following quote illustrates a common observation during group meetings: "While it is happening you are totally focused on sorting out the situation. Afterwards you joke harshly about it to keep fear at a distance". A striking observation was that crews repeatedly experienced the same type of near-injury event without taking any preventive measures. It happened that participants expressed frustration over the tension between being aware of risks and the economically necessary focus on productivity. Frustration and embarrassment were also expressed over the fact that safety measures well known to be necessary often were not implemented, even after repeated discussion in the groups. Suggested explanations for this were: Lack of time ('to-do-lists' were written but only the most urgent matters got seen to, families also demanded time), difficulty in finding a practical solution and lack of authority in the crew (difficult to influence decisions if you are not a skipper; some skippers are conservative).

Interviews: It was a general opinion that money severely restrained the possibility for safety improvements.

Observations: Participants were aware that not being well acquainted with routines or setting aside routines may lead to vastly enhanced risks, since safety depends on that everyone is doing things the way he is expected to and knows where the hazards are. This was often a problem after some time of absence from work and due to new crewmembers. A common way to handle these problems was to "take it a bit easy" for some time until everybody felt "run in". For some work operations that were known to be risky no set routines were reported to exist.

3.2.6 Safety action plans

Interviews: No existing plans for future improvements in safety were reported to exist at follow up.

Observations: The most clearly defined plan entailed testing and evaluation on three of the participating boats of a type of slip resistance that previously had not been used in fishery. Less slippery boots were also tested. However, one crew had just bought a new ship with improved safety and one crew was about to buy a new ship was not motivated to take measures on the present one.

3.2.7 Activity in safety work

Questionnaire: Four respondents reported increased and one reported decreased activity in safety work (p= .18).

Interviews: All but one of the respondents attributed increased general interest in safety, more interest in searching for hazards and a higher degree of participation in safety work on board to participation in the project. Four of the respondents reported that they had become more aware of consequences of injuries/near-injury events because safety at work was now more often reflected upon and discussed.

Observations: During the final group meetings, participants stated that they thought and discussed more about safety, followed routines more carefully and were more active in fixing safety related problems on board. These changes were attributed to participation in the project.

3.2.8 Perceived manageability of risks and risk acceptance

Questionnaire: One respondent reported increased and five reported decreased perceived manageability of risks (p=.16). Four respondents reported decreased and two reported increased risk acceptance (p=.31).

3.3 Feedback intervention study (study III)

Baseline medians, maximum and minimum values for modification occurrence proportions and modification breadths are shown in tables 7-8. No inter-condition variation with respect to baseline values was detected (Kruskal-Wallis; all p>.34).

In absolute figures, decrease in group level modification occurrence proportion was observed for ergonomic aspects. This trend was less marked for psychosocial aspects (Table 7). Inter-condition variation (Kruskal-Wallis; p=.085) with respect to change from baseline to follow-up was observed for modification occurrence proportion in the ergonomic area. All feedback conditions differed positively from controls in this respect (Table 7). For modification occurrence proportion in psychosocial aspects, no inter-condition variation with respect to change was indicated (Kruskal-Wallis; p=.202).

Table 7. Baseline values, change and difference vs. controls in group-level proportion of persons who reported work environment modifications.

Type of modification:	Study condition (all n=9)	Baseline Median Min; max	Change Median Min; max (%-units)	Median change difference vs. controls (% units)	p [a]	Critical p-value for overall alpha= .10 [b]
Ergonomic	Individual feedback	63% 36;100	0 -33; 33	33	.021	.033
	Supervisor feedback	86% 33; 100	-11 -33; 64	22	.042	.050
	Group feedback	88% 40; 100	-9 -50; 40	24	.094	.100
	Control	82% 55; 100	-33 -83; 9	.	.	.
Psychosocial	Individual feedback	89% 38; 100	0 -50; 25	11	.230	.
	Supervisor feedback	75% 44; 100	0 -11; 33	11	.040	.033
	Group feedback	70% 50; 100	0 -25; 23	11	.187	.
	Control	91% 75; 100	-11 -55; 6	.	.	.

Notes: [a]: Pairwise comparisons, intervention vs. control; Mann-Whitney U, 2-tailed.
[b]: Sequentially rejective Bonferroni test (see 2.6.3) (50)

For group level change, in absolute figures, with respect to modification breadth in the ergonomic as well as psychosocial areas, the general trend was negative (table 8). No inter-condition variation was detected for group level change with respect to modification breadth in the ergonomic area (Kruskal-Wallis, p=.175). For group level change with respect to modification breadth in the psychosocial area, inter-condition variation was detected (Kruskal-Wallis, p=.049). The supervisor feedback condition differed positively from controls (table 8).

Table 8. Baseline values, change and difference vs controls in group-level modification breadth.

Group average modification breadth:	Study condition All n=9	Baseline Median Min; max	Change Median Min; max	Median change difference vs. controls	p [a]	Critical p-value for overall alpha=.10 [b]
Ergonomic [c]	Individual feedback	1,5 0.6; 6.0	-0.4 -4.0; 0.3	1.6	.112	.
	Supervisor feedback	2.0 0.6; 6.4	-0.6 -3.8; 1.5	1.4	.102	.
	Group feedback	2.3 0.4; 3.9	0.1 -2.4; 1.8	2.1	.047	.033
	Control	2.8 1.1; 4.8	-2.0 -4.6; -0.1	.	.	.
Psycho-social [d]	Individual feedback	2.8 1.0; 6.0	-0.5 -3.0; 0.4	0.3	.659	.
	Supervisor feedback	2.5 1.7; 5.2	0.3 -1.3; 0.8	1.1	.024	.033
	Group feedback	2.8 1.3; 4.6	-0.7 -1.5; 0.7	0.1	.331	.050
	Control	3.1 2.3; 4.6	-0.8 -2.8; 0.6	.	.	.

Notes: [a]: Pairwise comparisons, intervention vs control; Mann-Whitney U, 2-tailed.
[b]: Sequentially rejective Bonferroni test (see 2.6.3)(50). [c, d]: Possible range c: 0-7; d: 0-8.

4 Discussion

4.1 Method

4.1.1 Validity

The studies in this thesis represented three different types of research design. The first study was of an exploratory nature and used a cross sectional design. Such a design does not warrant any conclusions about causality but is easy and inexpensive to perform. Further study of associations between cognitive factors, experience, attitudes, personality factors and activity in safety work should preferably use longitudinal designs.

The intervention study in fishery (study II) had as a major limitation with respect to internal validity its lack of controls. More valid conclusions concerning intervention effects will require a more controlled study. Such a study should also involve a larger number of participants or groups in order to get better statistical power. On the other hand, the longitudinal design involving prolonged contact between researchers and participants made relatively close observation of problem identification and subsequent action possible. Such observations are essential in order to learn about intervention processes and factors related to the feasibility of interventions but may be difficult to manage in a larger scale study.

One of the main concerns of the feedback intervention study (study III) was that it should be designed to have good internal validity. This was however not achieved in full. The study design included a couple of imbalances with respect to treatment between feedback and control conditions. First, ergonomic observation data for use in feedback were not collected in the control condition. Observation data collection may be considered an intervention, possibly generating increased awareness of workplace design and technique. However, the ergonomists were instructed to interfere with or comment on the subjects as little as possible during observation. Second, the study was not blind and controls were guaranteed equal treatment after the study period. Negative control group effects such as “demoralization”(20) or the adoption of a “wait-and-see attitude” may, at least partly, have accounted for the negative trend observed in the control condition. For modification occurrence proportions, this trend also accounted for the differences between intervention and control groups. Could this trend be interpreted as the result of processes that would have had impact on the feedback groups also, had they not been intervened into? During the study period, stress and burnout emerged as hot topics in the general debate in Sweden. This may have drawn attention from ergonomics towards stress. Psychosocial factors should be expected to be of concern in a stress context. Note that the negative trend was less marked with respect to psychosocial modification activity (tables 7-8). The concern with stress may in turn partly be explained by general trends towards increased time pressure in working life, leaving less energy and time for working environment issues.

Another limitation to this study was that data were collected by the feedback providers. Reporting bias in favour of feedback effects may have accounted for

observed effects. But since follow up data did not include any evaluative judgements about exposure, health or satisfaction with the intervention this seems less likely. In view of the results, powerful treatment diffusion effects (20) from intervention to control groups seem unlikely, although information provided during feedback may have been communicated to controls, thus diminishing observed effects. A similar possibility is that change impetus generated by feedback may have found its way to control groups through managerial or union pathways.

In short, I believe that observed effects may be inflated by some factors and deflated by others. Now, if we assume that the feedback intervention actually had effects, what component(s) of the intervention accounted for these? The feedback intervention had 3 main features: presentation of general information concerning working environment, some of it explicitly normative, specific information about local conditions (the feedback information) and, finally, discussion about these issues. From this study, no conclusion regarding the relative importance of these components can be drawn. Since people can observe their working environment themselves, it may well be the case that (effective) education, reflection and discussion of working environment issues were the active components, not the feedback component.

The questionnaire study among fishermen (study I) used a convenience sample. Readers should be aware that due to the fact that respondents were recruited among fishermen who participated in occupational safety and health projects or attended health check-ups, our sample may be unrepresentative with respect to the safety related variables in this study. After comparing proportion of skippers, ownership of fishing vessel, single crew fishing, age distribution, region of residence and civil status with information concerning the distribution of these factors among Swedish fishermen generally, we concluded that our sample was reasonably representative along the above dimensions, except for age (<35y underrepresented (19% vs. 30%), 35-49y overrepresented (47% vs. 35%) and ≥ 50y representative (34% vs 35%) and residence area (the west-coast overrepresented (73% vs. 45%)). Age was uncorrelated with the dependent variable activity in safety work. Residence area may be related to the variables under study here due to influence from local work cultures in fishery.

The intervention study in fishery (study II) had as major limitation the small sample size, which was mainly due to the fact that the study was of a pilot character that implied limited resources. Another reason was the practical difficulties in recruiting fishermen to our relatively time-consuming intervention. This in turn had to do with the fact that no tradition of participatory safety work of this kind existed in Swedish fishery. The intervention reached participants that were interested enough in safety issues to participate. So this is the population, biased in favour of safety interventions as it may be. For the same reasons as in study I, residence area may be of concern in study II also. I think that the external validity for study II should be considered mainly with respect to feasibility. I find no reason to not believe that this kind of intervention should be feasible among

interested Swedish fishermen generally. As for information concerning management of safety, generalisation is more problematic. Larger studies or case studies among crews carefully selected to be representative are desirable.

The study population for the feedback study (study III) was white-collar workgroups where computer work was common, where concern for ergonomics was held and where interest in engaging in research projects existed. Possible bias due to the latter factor seems to be a limited problem in this study; three quarters of the initially interested organisations could comply with randomisation and other study conditions, although I have no specific information concerning refusals, because of the study design, on the group level. The types of organisations represented the private as well as the public sector and were mixed with respect to type of production. The individual response rate was good for this type of study and was balanced across study conditions. I believe our results can be generalized to organisations and groups similar to those in this study.

4.1.2 Measurement variables

The measures used in the questionnaire study in fishery (study I) were designed mainly from theory. Standard measures were not used. One reason for this was the wish to try occupation-specific measures. This strategy made some study of (statistical) construct validity desirable. Our sample, because of its size and some skewed variables, was not ideally suited for factor analysis. The factor analytic results reported should be regarded as provisional as indicator of construct validity. It should also be noted that our measures of activity in safety work, risk acceptance, technical knowledge and fatalism could be improved, conceptually and psychometrically, by including more items - after a more careful selection procedure than was possible in the context of this study.

Concerning empirical validity of our measures of risk perception, perceived manageability of risks and technical competence, no criterion was available to us and thus we have no information about empirical validity. Our measures of activity in safety work, risk acceptance and fatalism suffers from the same weakness. We also suspect that the latter measures may suffer from social desirability bias, since data collection was managed by occupational health specialists and, for some data, in the context of an occupational health project.

These problems illustrate a dilemma of applied research in occupational groups with particular culture and working conditions. Generally applicable and proven instruments may not be very suitable in terms of operationalisation and may also be so general that within-occupation variation becomes small. Also, difficulties to obtain large and/or representative samples may limit the possibilities to perform technically sound method development work.

Measures in a strict sense played a minor role in the intervention study in fishery (study II). Observations and interview data were more important. The basic validity problems are the same for both kinds of data. Due to the fact that the researchers were also active as interventionists, the information concerning intervention effects may have been biased in favour of positive effects. This fact

may also account for possible bias in the registration and analysis of observations. Interview data may also be biased but should be so to a lesser degree since they were collected by an independent researcher. Questionnaire data were collected with an interval of almost a year, so it seems unlikely that follow-up data should be deliberately faked in favour of intervention effects, although the possibility cannot be ruled out. I think that a strength of the study was that 3 types of data were used and could be compared.

We think that qualitative information about injuries/near-injury events was valid. As for quantity, our impression is that all injuries were reported but that many near-injury events were not. Embarrassment, self-blame and a tendency to regard common types of near-injury events as normal may explain the tendency to underreport.

The feedback intervention study (study III) used as effect variables self-report measures of specific aspects of activity. It should be noted that activity to modify working conditions does not mean that the working conditions actually improve. It could be argued that improved exposure conditions should be the most appropriate type of evaluation variable for this kind of intervention. However, working life intervention research has shown that intervention effects on exposure conditions may be dependent on factors in the individual and organisational environment (45; 74; 83) that are not intervened into. Concerning feedback interventions speci-fically, Kluger and de Nisi (60) reviewed a large body of research and showed that feedback effects on task performance (in the context of this study, the task is to behave and arrange the working environment safely) must be regarded as highly unpredictable, since they may be mediated by the perceived validity of feedback information, task performance goals and motivation, the degree and character of eventual deviation from goals and psychological reactions to feedback. Feedback interventions with weak or no control over such factors can therefore not be expected to have specific effects in terms of improved working environment. It seems more reasonable to expect effects in terms of level of activity to modify working the working environment. Such activity may in turn be an expression of increased interest in working environment. However, it would have been highly desirable to have alternative effect data, such as independent observations of workplace design, working technique and job design, along with the self-reports used here.

I have no specific information concerning the validity of the kinds of self-reported information about alterations in workplace design, job design and working behaviour used here. Other researchers have studied the validity of self-report data on occupational activities, however. Concerning regularly occurring job tasks, Kallio et al (55) found that self-reports obtained through interviews had good validity with respect to the existence of the tasks as such. According to Campbell et al (17), referring to work postures and lifting, self-reports may have acceptable validity with reference to the occurrence of activities. Nordstrom et al (77) found self-reports on work activities of relevance for carpal tunnel syndrome to have acceptable validity in general terms. According to the authors cited in this

paragraph, the main validity problem with self-reported job behaviour may have to do with the quantitative dimension, which was not measured in this study. A problem here may however be due to the use of 6-month retrospective self-reports. Recall bias may have affected validity as well as reliability negatively.

4.1.3 Statistical analysis

The multiple regression in the questionnaire study among fishermen (study I) should be interpreted cautiously since the number of predictors in relation to sample size was large. The small sample size in the intervention study among fishermen (study II) led to low statistical power.

In the feedback study (study III) results were analysed on a group level. This was because unit of analysis should be the same as unit of randomisation. This procedure led to loss of power. However, data from the same project, analysed on the individual level, were reported in another publication (29). Corresponding results in that study were similar to the ones presented here.

In interpreting results concerning feedback effects we have accepted an alpha level of 0.10. It can be argued that the consequences of falsely rejecting a null hypothesis in this kind of study are probably smaller that the consequences of falsely accepting it. According to Swedish legislation, employers are obliged to keep themselves informed about working environment conditions and to involve their employees in working environment issues, which commonly involve some kind of feedback of working environment data. So falsely concluding that feedback is effective as a tool for stimulating work environment activity will have minor consequences compared to the risk of missing the opportunity to improve on a practice that is in common use.

4.2 Discussion of results

4.2.1 Study I

Self reported activity in safety work was, on the average, high. It remains to be investigated what this means in absolute terms. On the basis of the fact that injury frequency is high it appears that the safety measures taken among the fishermen under study lacked power to prevent injuries.

Injury/near-injury event experience was not correlated to activity in safety work. This implies that the fishermen did not effectively learn from experience, suggesting that an objective for safety work should be to support such learning.

On the average, risks were not perceived to be very high. These results should be viewed in the light of fishery being one of the most injury stricken occupations. Perceived risk level did not predict activity in safety work. As a consequence, interventions aimed solely at increasing perceived risk seem less promising in safety work. Witte *et al*. (96) found that a high score for perceived threat predicted active safety behaviour. However, the same authors concluded that efforts to increase perception of threat should, to be effective, be accompanied by efforts to promote perceived efficacy of safety measures. In the present study perceived manageability of risks predicted higher activity in safety work. A similar relation

was found by Goldberg *et al*. (38), who noted that activity in safety work was higher among workers having received safety instruction and perceiving co-worker support in relation to safety work. This suggests that activity in safety work may be stimulated through analyses of injuries and near-injury events, in order to clarify how the courses of events could be influenced and modified. Another suggestion is that activity in safety work might reinforce perceptions of manageability, possibly forming a positive feedback loop.

Results concerning risk acceptance did not give support to the notion that fishermen in general were in favour of a fearless attitude. However, as noted above, this finding might be biased.

Although we could not find any PubMed- or PsychINFO-indexed study of associations between civil status and degree of activity in injury prevention, we expected that having some kind of family responsibility would be positively associated with activity in safety work, particularly in a dangerous occupation such as fishery. Our results suggested that civil status might predict activity in safety work. Specifically, being single appeared to predict higher activity in safety work. This finding was contrary to our expectations and seem inconsistent with research (8; 37) that has indicated higher injury rates among singles. We cross-validated our regression model using randomly selected 70% subsamples (not reported here) and found civil status to be an unstable predictor however.

Self rated technical competence (as an index variable) appeared as a predictor in the final regression model. However, partial correlation analyses on the specific variable level showed that self rated technical competence regarding equipment for navigation and supervision, but not the two other items in the technical competence index, was (significantly) associated with activity in safety work. It thus appeared that general perception of technical competence was in fact not a good predictor of activity in safety work. Instead, a specific aspect of such competence, which in turn may be an expression of some individual or occupation-specific characteristic not measured in this study, appeared to predict activity in safety work.

4.2.2 Study II

The intervention design proved sensitive to dropout but was effective with respect to achieving a serious discussion on safety issues. The structured analysis of injuries/near-injury events worked smoothly and facilitated verbalisation of experience, experience exchange and documentation. We think that the focus on specific, identified problems made discussion on distribution of authority, norms and definition of acceptable safety level motivated and natural among crew. The distinction between basic cause and releasing factor was not always clear to the participants and we think the group discussions played a role in making this clearer. A major effect of structured near-injury event reporting was to put problems of identification and memorization in focus. Diaries proved to be unreliable in this respect, but may still have a practical value. Near-injury events involving slips occurred repeatedly but were normally not noted in diaries or

reported spontaneously at group meetings. A previous (more representative) study of occupational injuries in fishery also found falls and slips to be common (91). This suggests that some of he most prevalent hazards are ignored.

Results suggested a large potential for prevention through technical, but also organisational, measures. In order to be accepted, solutions should be robust and practical.

The emotional experience of injuries or near-injury events seemed to linger and express itself in terms of frustration and embarrassment. It seemed that such experience did not motivate direct action to solve safety problems. A similar result was found in study I. Interaction between structural, social and psychological factors seemed to explain why experience from injuries or near-injury events seldom lead to preventive measures, so this should be given priority in further safety intervention work.

Questionnaire results concerning perceived manageability of risks, risk acceptance and activity in safety work did not indicate any statistically significant change. However, the results suggested decreased perceived manageability of risks. This may reflect that the group discussions made safety problems more explicit and dealt with difficulties associated with preventive work. A longer or more intensive intervention may be necessary in order to progress from problem orientation to action orientation. We think, however, that the intervention was effective in stimulating activity in safety work and that it initiated some specific measures.

The study indicated that, although sensitive to dropout, participative, talk-based safety interventions in fishery are feasible and may be effective.

4.2.3 Study III

This study examined effects of feedback of working environment and working technique information to individuals, supervisors and groups, respectively, on working environment modification activity (group level modification occurrence proportions and modification breadths). Effect was defined as difference vs. controls with respect to change from baseline to follow-up in working environment modification activity. All feedback conditions differed positively from controls regarding group level proportion of persons whose working environment had been modified (modification occurrence proportion) with respect to ergonomics. Decline in activity in the control groups vs. relative stability of activity level in the intervention groups accounted for the observed effect. No such effect was found for psychosocial factors. Feedback to supervisors was the only condition that differed (positively) from controls with respect to group level average number of individual level modification types (modification breadth) with respect to psychosocial factors. No such effect was observed regarding ergonomics.

Our results do not warrant any statistically based conclusion concerning which feedback variant, if any, was most effective in the respects studied here. Note, though, that the supervisor feedback condition was the only one to show effect in

both ergonomic and psychosocial aspects and was also the variant associated with the smallest investment of working time.

Other research on feedback as a working life intervention has concluded that that feedback effects on exposure or health are dependent on a multitude of factors that may be beyond the control of researchers, interventionists or participants. So one may ask: Is feedback of any use at all when not applied in the context of an intervention with control over all those factors? The results from this study suggested that feedback may have effects on working environment modification activity. Such activity should be seen as practical experimentation, the results of which should ideally generate another feedback cycle, leading to new experimentation and so forth, eventually resulting in improved health and exposure conditions.

4.2.4 Intervention feasibility

Before any intervention effects are evaluated, the feasibility of the intervention design should be tested. An intervention that is not possible to implement according to design and intention cannot be expected to have the intended specific effect. In study II the feasibility of the intervention design was one of the main issues tested. Since participative talk-based interventions were a novelty in fishery, feasibility should be seen as a major outcome in study II. The situation is different regarding feedback interventions. Such have been used and evaluated for decades. The feasibility issue in study III had to do with the feasibility of randomised controlled studies in working life settings. Such studies are uncommon and may be questioned on ethical grounds. This is because they involve different treatment of experimental and control groups. Randomised studies in working life settings are also uncommon because organisations may be reluctant to engage in such studies. I believe that good and well-established researcher-interventionist relations and interventionist-organisation relations are essential. The fact that the intervention had to do with a “hot topic” (ergonomics of computer work) is also likely to have contributed to the organisations´ motivation to participate.

4.3 Comparison of the two different approaches to intervention

The intervention studies represented two distinctly different methodological approaches. The process-oriented intervention in fishery involved several intervention occasions and generated specific information about problems and possibilities of safety work among fishermen. Its major drawback (as an intervention effect study) was poor internal validity. The feedback intervention study was stronger in terms of internal validity, but gave no process information. Such information would have been valuable e.g. for the understanding of why little change occurred in intervention groups and why negative change occurred in control groups. Adherence to established survey feedback intervention designs (23; 74; 83) would have made process data available, since such designs include several intervention occasions. The feedback intervention studied here used a simplified procedure and involved only one intervention occasion. From an

intervention perspective, this had do to with feasibility and economy and could be regarded as reasonable, bearing in mind that it was intended as a technique for everyday occupational health service work. From an experimental study perspective this simplification of classical survey feedback design was something of a necessity in order to obtain some degree of experimental control.

I think that process oriented and experimental intervention studies are equally necessary. Process studies are useful for getting information about the feasibility of different intervention components and preliminary evidence concerning their specific effects. Stronger effect evidence could then be obtained through experimental study of specific promising components. Finally, evidence based packages of such components could be combined into more complex interventions according to specific needs.

4.4 Conclusions

The questionnaire study among fishermen suggested that although fishery is one of the occupations where injuries are most common, the perceived risk level was not high. The respondents tended towards high perceived manageability of risks, low degree of fatalism, moderate degree of risk acceptance, good self-rated technical competence and relatively high self-reported activity in safety work. Perceived manageability of risks, but not injury/near-injury event experience, perceived personal risk, risk acceptance or fatalism, was (positively) associated with activity in safety work.

Results from the intervention in fishery suggested that the perceived manageability of risks may have decreased during the intervention period. This may reflect that the group discussions made safety problems more explicit and dealt with difficulties associated with preventive work. The questionnaire study as well as observations from the intervention study indicated that experience from actual or potential injury situations did not motivate preventive measures. Another observation was that common events associated with injury risk often were not identified as deviations from the normal.

Observations during the intervention process suggested that the intervention was effective in stimulating activity in safety work, but this was not supported by follow-up questionnaire data. The study indicated that, although sensitive to dropout, participative, talk-based safety interventions in fishery are feasible and may be effective.

The feedback intervention study among office workers indicated positive effect on modification activity regarding ergonomic aspects in all feedback conditions. For psychosocial aspects, positive effect on modification activity was observed in the supervisor feedback condition only. The results suggested that feedback interventions similar to the one studied may, in order to maximize cost-effectiveness, be directed directly to supervisors or managers.

Summary

Eklöf M. (2003) *Event analysis and feedback as intervention techniques to stimulate activity for safe and healthy work*. Arbete och Hälsa 2003:1.

The general aim of this licentiate thesis was to contribute to the research-based knowledge about working-life interventions for improved safety and health. Interventions were made among Swedish fishermen (problem: high incidence of occupational injuries) and white-collar computer workers (problem: high prevalence of musculoskeletal illness).

Earlier research has indicated that psychological factors such as risk acceptance might counteract activity in safety work among fishermen. In order to test the validity of this in Swedish fishery, a pilot questionnaire study was conducted using a convenience sample (n=92) of Swedish fishermen. The results suggested that although fishery is one of the occupations where injuries are most common (62% of our sample reported experience from injury related events), the perceived risk level was not high. The respondents tended towards high perceived manageability of risks, low degree of fatalism, moderate degree of risk acceptance and relatively high self-reported activity in safety work. Perceived manageability of risks, but not injury/near-injury event experience, perceived personal risk, risk acceptance or fatalism, was (positively) associated with activity in safety work.

The intervention in fishery was based on participative principles and used researcher-led group-discussions of occurred events during work, where group members was or could have been injured, as a method. It had as a main aim to explore and generate learning among participants about how risks could be managed preventively. Since this kind of intervention was a novelty in Swedish fishery, feasibility was also a main issue. The study relied mostly on qualitative data from observations and interviews, but also had a pretest-posttest one group quasi-experimental design. The studied group had less than ten members, so the statistical power was low. Results suggested that, contrary to intention, the perceived manageability of risks may have decreased during the intervention period. This may reflect that the group discussions made safety problems more explicit and dealt with difficulties associated with preventive work. The questionnaire study as well as observations from the intervention study indicated that experience from actual or potential injury situations did not motivate preventive measures. Another observation was that common events associated with injury risk often were not identified as deviations from the normal.

Qualitative information suggested that the intervention was effective in stimulating activity in safety work, but this was not supported by follow-up questionnaire data. The study indicated that, although sensitive to dropout, participative, talk-based safety interventions in fishery are feasible and may be effective.

The intervention among white-collar workers was based on feedback methods. The study was a pretest-posttest cluster-randomised controlled study. The effect

studied was group-level change in activity to modify working environment or work postures from pretest to posttest. Thirty-six workgroups (304 persons) from 9 organisations participated and were randomised to one of 3 feedback conditions or a control condition with no feedback. The feedback conditions were: Individual feedback to each group member (individual and group-level data), individual feedback to group supervisor (group level data) and to entire groups (group-level data). The feedback information included psychosocial factors, comfort during computer work, musculosceletal symptoms, ergonomic standard of equipment and working-technique. Follow up was 6 months after intervention. For ergonomic aspects, positive effect on modification activity was observed in all feedback conditions. For psychosocial aspects, positive effect on modification activity was observed in the supervisor feedback condition only. The validity of conclusions regarding feedback effects may be limited due to possible negative control group effects and reporting bias. The results suggested that feedback interventions similar to the one studied might, in order to maximize cost-effectiveness, be directed directly to supervisors or managers.

Keywords: Computer work, ergonomics, feedback, fishery, occupational injury participation, risk perception, safety attitudes, working life intervention.

Sammanfattning (Summary in Swedish)

Eklöf M. (2003) *Event analysis and feedback as intervention techniques to stimulate activity for safe and healthy work*. Arbete och Hälsa 2003:1.

Denna licentiatavhandling hade som allmänt mål att bidra till den forskningsbaserade kunskapen om arbetslivsinterventioner för bättre hälsa och säkerhet. Interventioner genomfördes bland svenska yrkesfiskare (problem: hög förekomst av olycksfallsskador i arbetet) och tjänstemän som använde datorer i arbetet (problem: hög förekomst av muskuloskeletala besvär).

Tidigare forskning har indikerat att psykologiska faktorer som fatalism och accepterande av risker kan motverka aktivitet för ökad säkerhet bland fiskare. För att pröva giltigheten, bland svenska fiskare, hos sådana slutsatser genomfördes en enkätstudie av pilotkaraktär i ett bekvämlighetsurval (n=92) av svenska yrkesfiskare. Resultaten antydde att skaderisken inte uppfattades som direkt stor, detta trots att fisket är en av de mest skadedrabbade branscherna (62% av vår studiegrupp hade erfarenhet från skadehändelser). Andra tendenser var att man uppfattade möjligheterna att hantera olika riskmoment som goda, att man inte rapporterade hög fatalism eller högt riskaccepterande och att man rapporterade hög aktivitet i säkerhetsarbete. Den uppfattade möjligheten att hantera riskmoment hade positivt samband med aktivitet i säkerhetsarbete. Däremot fanns inga samband mellan erfarenhet från skadehändelser, uppfattad skaderisk, accepterande av risker samt fatalism å den ena och aktivitet i säkerhetsarbete å den andra sidan.

Interventionen bland yrkesfiskare var baserad på participativa principer och använde forskarledda gruppdiskussioner av händelser under arbetet, där någon av gruppmedlemmarna blev eller hade kunnat bli skadad, som metod. Målet var att undersöka och åstadkomma erfarenhetsbaserat lärande om hur skador skulle kunna förebyggas. Eftersom denna typ av intervention var en nyhet inom svenskt fiske var även själva genomförbarheten en fråga av intresse. Studien byggde huvudsakligen på kvalitativ information från observationer och intervjuer, men hade även en engrupps pretest-posttest design. Studiens statistiska power var emellertid låg på grund av att gruppstorleken var mindre än tio personer. Resultaten antydde att de uppfattade möjligheterna att hantera riskmoment hade minskat under interventionsperioden. Detta var tvärtemot intentionerna. Detta kan avspegla det faktum att gruppdiskussionerna gjorde säkerhetsproblemen tydligare och att svårigheterna med säkerhetsarbete tenderade att hamna i fokus.

Enkätundersökningen liksom observationer under interventionsprocessen indikerade att erfarenhet från skadetillfällen eller –tillbud inte i någon högre grad motiverade preventiva åtgärder. Ytterligare en observation var att vanliga händelser förknippade med skaderisk ofta inte uppfattades som tillbud eller avvikelser från det normala. Kvalitativ information antydde att interventionen hade positiv effekt på aktiviteten i säkerhetsarbete, men detta stöddes inte av enkätdata från eftermätningen. Studien visade att participativa samtalsbaserade

interventioner för ökad säkerhet i yrkesfiske är genomförbara och kan vara effektiva.

Interventionen bland tjänstemännen var baserad på feedbackmetoder. Studien var en klusterrandomiserad kontrollerad studie. Den effekt som studerades var förändringar på gruppnivå när det gällde aktivitet för att förändra arbetsmiljö och arbetsställningar.

Trettiosex arbetsgrupper (304 personer) från nio organisationer deltog och randomiserades till en av tre feedbackbetingelser eller en kontrollbetingelse utan feedback. Feedbackbetingelserna var (1) individuell feedback till varje gruppmedlem (data på individ- och gruppnivå), (2) individuell feedback till respektive grupps arbetsledare (data på gruppnivå), (3) feedback till hel arbetsgrupp (data på gruppnivå). Feedbackinformationen inkluderade psykosocial arbetsmiljö, komfort i samband med datorarbete, muskuloskeletala symptom, ergonomisk standard på arbetsplatsen och utrustningen samt arbetstekniken. Uppföljningen gjordes sex månader efter interventionen. Resultaten indikerade en positiv effekt i alla feedbackbetingelser när det gällde aktivitet för att förändra belastningsergonomiska aspekter av arbetet. För psykosociala aspekter konstaterades effekt endast för feedback till arbetsledare. Validiteten hos dessa resultat kan vara begränsad på grund av negativa kontrollgruppseffekter och bias.

Sammantaget antydde resultaten att feedbackinterventioner av det studerade slaget med fördel kan riktas till enbart arbetsledare.

Nyckelord: Arbetslivsintervention, arbetsskada, attityder till säkerhet, datorarbete, ergonomi, feedback, participation, riskuppfattning, yrkesfiske.

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